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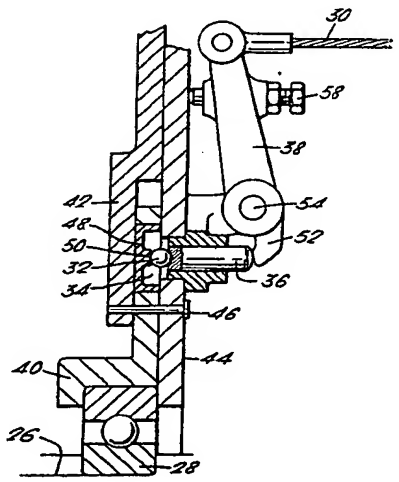
(54) Means for detecting relative movement between parts of machines

(57) A machine is provided with parts which are relatively movable when a predetermined force is applied to them. The machine is adapted to detect such relative movement and indicate when that relative movement exceeds a predetermined value. In a gas turbine engine, a bearing housing 40 is located between support plates 42, 44 by means of shear bins 46 such that in the event of unbalance of the rotor occurring, the pins shear and the housing displaces so releasing the trigger 36 which results in shutting off the fuel supply, or the operation of a warning.

Fig. 2.



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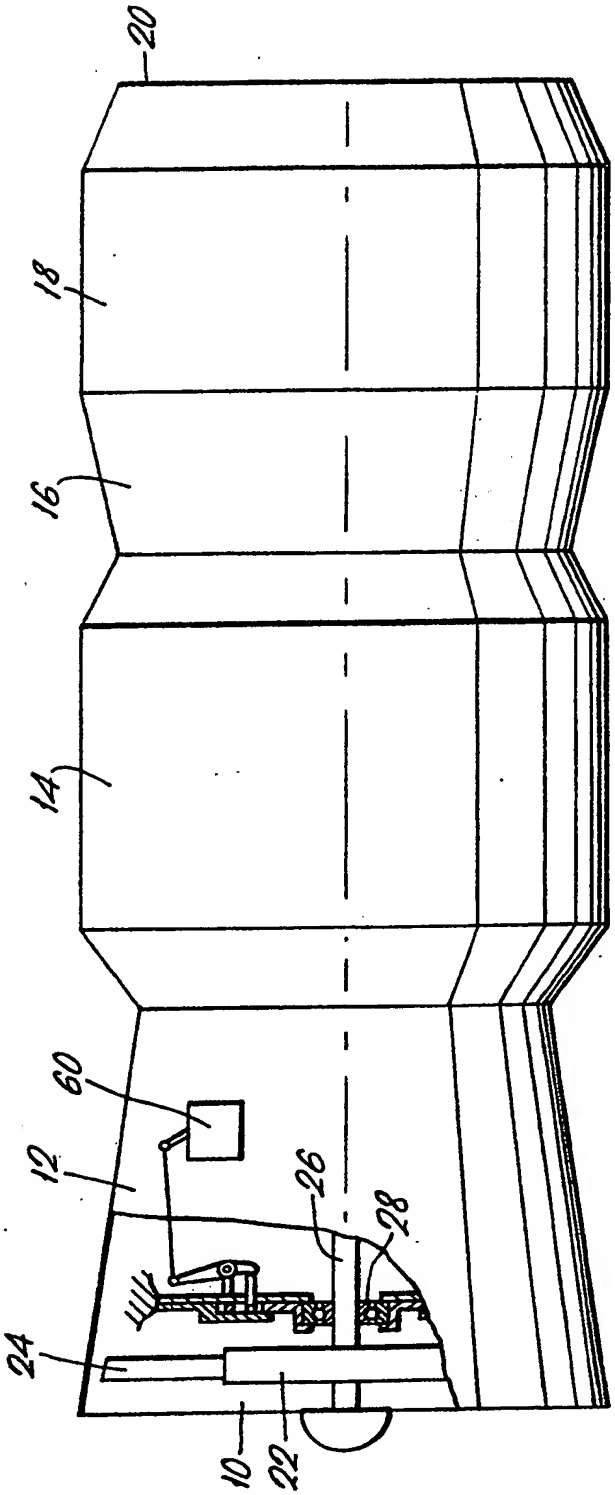

Fig. 1.

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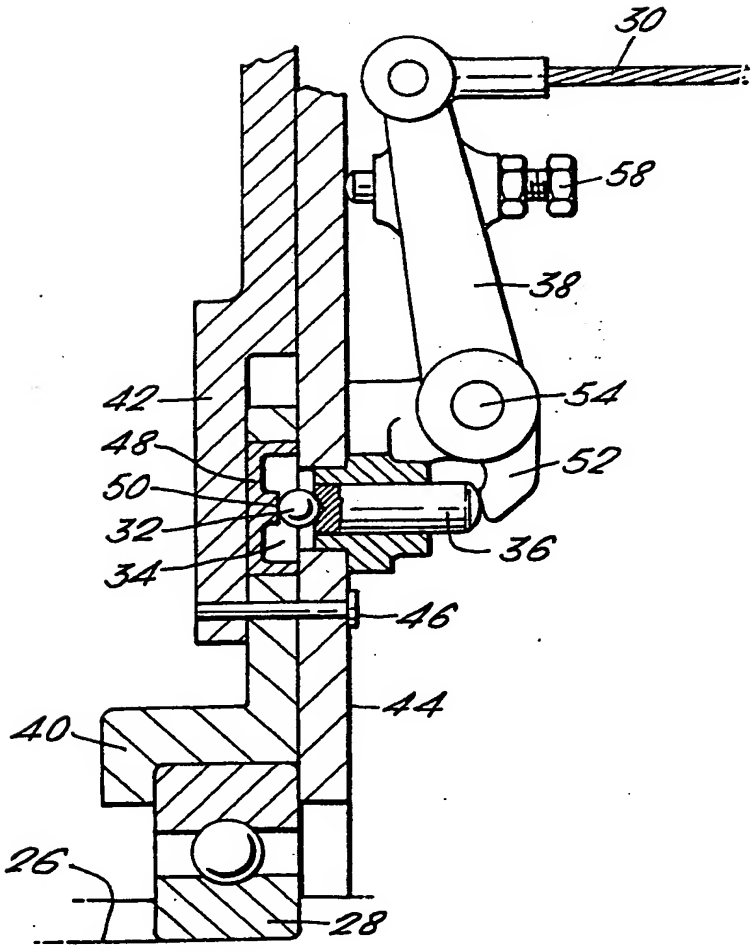
Fig. 2.



SPECIFICATION

Improvements in or relating to machine

This invention relates to machines and particularly to means for indicating or dictating when a machine which has relatively moving parts should be stopped.

Thus with rotary machines such as gas turbine engines, a sudden out-of-balance in the rotating parts can have catastrophic effects. In a gas turbine engine, for example, if a blade becomes detached from the rotor resulting in a change in the centre of rotation of the rotor, the rotor is allowed to rotate about its new centre of rotation allowing the rotor shaft to orbit whilst still being held in its axial position. This is normally achieved by mounting the shaft bearing so that when the centre of rotation of the rotor changes, a limited amount of radial movement of the bearing and the shift is permitted.

It is also desirable to stop a rotary machine which is excessively out-of-balance. It is an object of the present invention therefore to utilise relative movement between two parts of a machine to indicate when the machine should be stopped.

According to the present invention a machine has means for permitting relative movement between parts of the machine on the application of a predetermined force, means for detecting the relative movement and means for indicating when the relative movement exceeds a predetermined value.

Preferably the means for permitting relative movement between the parts comprises supporting means adapted to support the parts, the supporting means being permitted to move on the application of a predetermined load.

Preferably the supporting means is located by a plurality of shear pins which are adapted to shear when a predetermined load is applied thereto whereby to permit the movement of the supporting means and relative movement between the parts.

Preferably the machine comprises a rotary machine having means for permitting radial movement of a rotor shaft in the event of an out-of-balance force on the rotor, means for detecting the radial movement of the shaft and means for indicating when the radial movement exceeds a predetermined value.

Preferably the means for permitting radial movement of the rotor shaft comprises a bearing adapted to support the shaft, the bearing being permitted to move radially on the application of a predetermined radial load.

Preferably the bearing is located by a plurality of shear pins which are adapted to shear when a predetermined radial load is applied thereto whereby to permit the radial movement of the bearing.

The bearing is preferably located in a housing carrying a recess, and there is provided a spring urged plunger urged into engagement with the housing, the plunger entering the recess when the housing moves a predetermined distance.

The plunger may be connected to means for stopping the rotary machine or connected to indicating means adapted to indicate that the rotary machine should be stopped.

Between the plunger and the housing there is preferably located a ball whereby a predetermined movement of the housing disengages the ball from its position and permits the plunger to enter the recess in the housing.

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatical representation of a gas turbine engine constructed in accordance with the invention and

Figure 2 is enlarged detailed view of the mechanism of the invention.

Figure 1 illustrates a gas turbine engine comprising an air intake 10, compressor means 12, combustion equipment 14, turbine means 16, a jet pipe 18 and a propelling nozzle 20, all arranged in flow series.

The compressor means 12 is cutaway to show a rotor 22 with a plurality of blades 24 mounted on its periphery. The rotor is mounted on a shaft 26 which is supported on bearings, one of the bearings 28 being illustrated.

The mounting of the bearing 28 is illustrated in more detail in Figure 2, and it will be seen that the bearing 28 is located in a housing 40, the housing being held between two supporting plates 42 and 44 by a number of shear pins 46, only one of which is shown.

Formed in the housing 40 is a hole 34, and located in this hole is an insert 48 having a cup-like shape with a central raised portion 50.

Pivoted from the supporting plate 44 is a lever 38 which is provided below its pivot 54 with an extension 52. This extention 52 abuts a plunger 36, and between the plunger 36 and the raised portion 50 is located a ball 32. The end of the plunger 36 is slightly recessed for location of the ball 32. The extension 52 is pushed tightly against the plunger 36 and the ball 32 by an adjuster 58 mounted on the lever 38. Attached to the end of the lever 38 is a cable 30, and this is connected to a shut-off-cock in the fuel system. The cable 30 and hence the end of the lever 38 is urged by spring means to the right when viewed in the drawings.

If the rotor 22 suddenly becomes out-of-balance by, for example, the loss of one or more blades 24, then the rotor will attempt to rotate about a new centre of rotation. This will cause radial loads on the bearings 28, and if the radial load is sufficient, the shear pins 46 will shear allowing the housing 40 to move radially and permitting the bearing to orbit around the new centre of rotation of the rotor 22.

A sufficient radial movement of the housing 40 will move the raised portion 50 clear of the ball 32, and the ball will move into the outer part of the insert 48 permitting the plunger to be pushed into the insert 48 by the extension 52. The lever 38 will move in a clockwise direction and cause the shut-off-cock 60 to be operated, thus cutting off the fuel supply to the engine, and shutting it down.

Various alterations can be made to the mechanism without departing from the scope of the invention. Thus the lever 38 could simply be connected to a

warning device to alert the aircraft pilot of the out-of-balance condition so that the engine could be shut down manually.

The mechanism can also be made to operate at predetermined out-of-balance forces on the rotor 22 by a suitable choice of the strength of the shear pins 46, and the plunger 36 only allowed to move with a predetermined radial movement of the housing 40 by a suitable choice of the radial dimension of the raised portion 50 and/or the size of the ball 32.

Whilst the invention has been described applied to a gas turbine engine it could be particularly useful on any machinery in which relative movement between two parts of the machinery is undesirable.

CLAIMS

1. A machine having means for permitting relative movement between parts of the machine on the application of a predetermined force, means for detecting the relative movement and means for indicating when the relative movement exceeds a predetermined value.

2. A machine as claimed in claim 1 wherein the means for permitting relative movement between the parts comprises supporting means adapted to support the parts, the supporting means being permitted to move on the application of a predetermined load.

3. A machine as claimed in claim 2 wherein the supporting means is located by a plurality of shear pins which are adapted to shear when a predetermined load is applied thereto whereby to permit the movement of the supporting means and relative movement between the parts.

4. A machine as claimed in any one preceding claim wherein said machine comprises a rotary machine having means for permitting radial movement of a rotor shaft in the event of an out-of-balance force on the rotor, means for detecting the radial movement of the shaft and means for indicating when the radial movement exceeds a predetermined value.

5. A machine as claimed in claim 4 wherein the means for permitting radial movement of the rotor shaft comprises a bearing adapted to support the shaft, the bearing being permitted to move radially on the application of a predetermined radial load.

6. A machine as claimed in claim 5 wherein the bearing is located by a plurality of shear pins which are adapted to shear when a predetermined radial load is applied thereto whereby to permit the radial movement of the bearings.

7. A machine as claimed in claim 5 or claim 6 wherein the bearing is located in a housing carrying a recess and there is provided a spring urged plunger urged into engagement with the housing, the plunger entering the recess when the housing moves a predetermined distance.

8. A machine as claimed in claim 7 wherein the plunger is connected to means for stopping the rotary machine or connected to indicating means adapted to indicate that the rotary machine should be stopped.

9. A machine as claimed in claim 7 or claim 8 wherein between the plunger and the housing there is located a ball whereby a predetermined movement of the housing disengages the ball from its position and permits the plunger to enter the recess in the housing.

10. A machine as claimed in any one preceding claim wherein said machine is a gas turbine engine.

11. A machine substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

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